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NOTES ON GEOGRAPHIC DISTRIBUTION

Extending the distribution of *Ramalina lacera* (With.) J. R. Laundon (Ramalinaceae, lichen forming Ascomycota): First record from eastern South America

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ABSTRACT: The lichen forming fungus *Ramalina lacera* is reported for the first time from Brazil. The specimens were collected in the State of Rio Grande do Sul (Southern of Brazil), only on rocks and between 210 m to 350 m altitude. A distribution map, figure and comments on the species are provided.

Ramalina Ach. is a cosmopolitan genus with *ca*. 150 to 200 species (Kashiwadani and Nash 2004; Sérusiaux *et al.* 2010). Generally the species have a greenish gray to yellowish-green fruticose thallus, always producing usnic acid. The branches may vary from flat to cylindrical, from solid to hollow, and often produces pseudocyphellae (*e.g*. Krog and James 1977; Krog and Østhagen 1980; Kashiwadani and Kalb 1993). The anatomy of the branches is also variable, which can often present a cortical layer followed by a chondroid tissue and a medulla (Kashiwadani and Kalb 1993; Kashiwadani and Nash 2004). The ascospores are hyaline, usually 2-celled and varying from ellipsoid to fusiform (*e.g.* Krog and James 1977; Kashiwadani and Nash 2004).

Ramalina lacera (With.) J. R. Laundon is a remarkable member of the genus due to the absence of a supportive hyphal layer called chondroid tissue (Kashiwadani and Kalb 1993, Kashiwadani and Nash 2004). This layer is present in the majority of species of *Ramalina*. The species is also unusual within the genus because of the production of bourgeanic acid in the medulla (Kashiwadani and Nash 2004), a compound that is rarely produced in *Ramalina*.

Although Laundon (1984) considered *Ramalina duriaei* (De Not.) Bagl. to be a synonym of *R. lacera*, many authors have continued using the name *R. duriaei* (*e.g.* Canaani *et al*. 1984; Epstein *et al*. 1986; Garty 1987; Lurie and Garty 1991; Garty *et al*. 1993; 1997; Silberstein *et al*. 1996); thus, most records of *R. lacera* remain under the synonym.

Ramalina lacera has a broad but somewhat spotted distribution (Figure 1). It is known from Europe (*e.g*. Krog

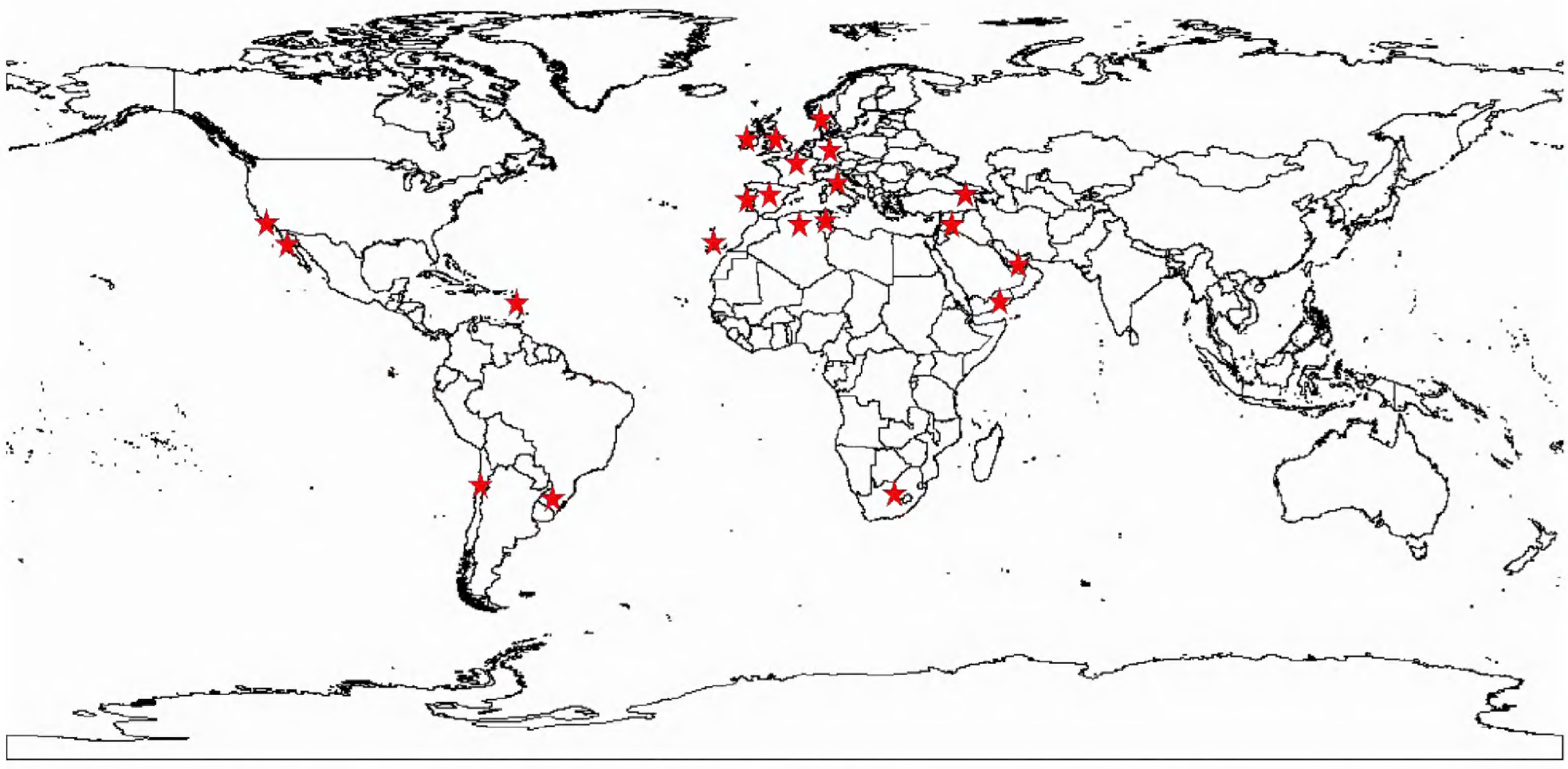

FIGURE 1. Worldwide distribution map of *Ramalina lacera* (red stars) based on previous publications and the new records. Source: Modified from Software DIVA-GIS, Version 7.5.

and James 1977; Jatta 1889, 1911; Follmann 1980; Jones 1980; Bruyn 2000; Alvarez *et al.* 2001), west of Asia (*e.g.* Canaani *et al.* 1984; Epstein *et al.* 1986; Sipman 2002; Yazıcı *et al.* 2011), Africa (*e.g.* De Notaris 1846; Baglietto 1879; Doidge 1950; Krog and Østhagen 1980; Follmann and Mies 1986; Follmann and Sanchez-Pinto 1987; Van Haluwyn *et al.* 1994; Egea 1996; Aptroot 2012), southwest of North America (Howe 1913; Rundel *et al.* 1972; Kashiwadani and Nash 2004) and Central America (Howe 1913; Rundel *et al.* 1972). In South America it was reported only from northern Chile (Rundel 1978). In this study, we report the occurrence of *R. lacera* in the most southern state of Brazil, Rio Grande do Sul, in two sites located at approximately the same latitude as the Chilean specimen, and extending its distribution to the east of South America.

The study is based on unidentified specimens collected by Dr. Mariana Fleig between 1989 and 1998 housed in the Herbarium of Universidade Federal do Rio Grande do Sul (ICN). They were examined using standard stereoscopic (20–40×) and light microscopic (400–1000×) techniques. Sections of thallus and apothecia were mounted in water. Chemical constituents were identified by spot tests, under UV light and thin layer chromatography (TLC) using solvent system C (Orange *et al.* 2001).

Ramalina lacera (With.) J. R. Laundon, Lichenologist 16: 220. 1984. Figure 2

Basionym: *Lichen lacerus* With., Bot. Arr. Veg. Gr. Brit.: 716. 1776.

Lectotype (designated by Laundon, 1984): Dillenius (1742: 163): tab. 21, fig. 57B (OXF).

Description: thallus solid, shrubby, up to 6.0 cm tall, pale stramineous in herbaria, growing from a common holdfast, irregularly palmate branched, dichotomous in narrow branches, branches flatted, bifacial, main branches up to 1.3 cm wide and terminal branches up to 1.0 mm wide, 200–500 µm thick, surface weakly to clearly scrobiculate; pseudocyphellae very rare, orbicular, flat, up to 0.1 mm in diam.; soralia at first marginal then becoming laminal, mainly in upper parts of thallus, laminal soralia growing mainly on top of the wrinkle, soredia (300–) 400–600 µm in diam. Cortex dirty yellow, continuous, 25–45 µm thick, chondroid tissue absent, medulla white, dense, 120–380 µm thick, algal layer almost continuous, 50–60 µm thick. Apothecia orbicular, concave to mainly flat, up to 5.0 mm in diam., without pruina, with marginal to rarely submarginal soralia, up to 0.6 mm long. Epihymenium brownish, 10–15 µm thick, hymenium hyaline, 35–40 µm thick, subhymenium hyaline to weakly grayish, 25–35 µm thick, algal layer under the hymenium present, continuous, 50–55 µm thick; ascospores hyaline, 1-septate, weakly curved to straight, 10–14 × 4–5 µm. Pycnidia not found.

Spot tests: cortex K-, C-, KC+ yellow, UV-; medulla K-, C-, KC-, UV-. TLC: bourgeanic acid (in medulla) and usnic acid.

Substrate and ecology: According to Kashiwadani and Nash (2004) this species occurs mainly on branches of

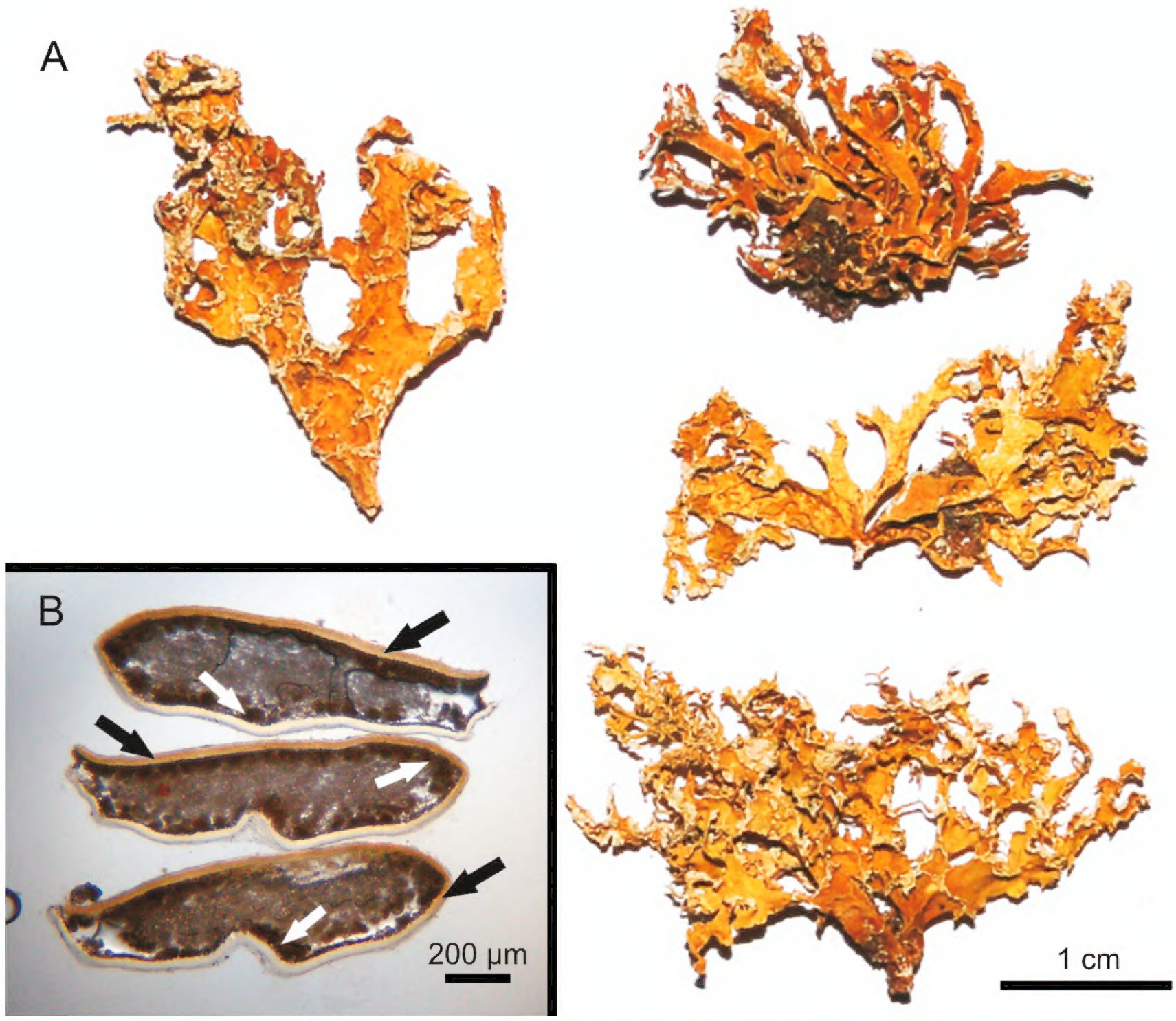

Figure 2. Thallus of *Ramalina lacera* (M. Fleig 7247). B. Anatomical section of branches. Black arrows indicate the cortex. White arrows indicate the algal layer. The gray central area in the thallus is the dense medulla.

various trees and rarely on rock, and Krog and Østhagen (1980) stated it can be corticolous or saxicolous, occurring in rather dry, well lit sites and often in man-made habitats. The specimens from Brazil were growing only on rocks, between 210 m to 350 m alt.

Material examined: BRAZIL. **State of Rio Grande do Sul**: Municipality of Bagé, Casa de Pedra, 14 Km in parallel road to highway BR 153, 210 m alt., 03.XI.1989, *M. Fleig 3907* (ICN), *ibid.*, 04.XI.1989, *M. Fleig 4001* (ICN), *ibid.*, 350 m alt., 15.XII.1989, *M. Fleig 4144* (ICN); Municipality of Caçapava do Sul, Pedra do Segredo, undisturbed place, 27.XI.1993, *M. Fleig 5948* (ICN), *ibid.*, on rock protected by shrubs, 300 m alt., 15.IX.1998, *M. Fleig 7247* (ICN).

Additional species examined: ***Ramalina canariensis*** J. Steiner: GRAN CANARIA, Tafira, 400 m, 22 May 1900, *J. Bornmüller*, Pl. Canar. No. 3500 (W, isolectotype). ***Ramalina mollis*** Krog and Østh.: THE CANARY ISLANDS, Lanzarote, La Geria, ca. 5 Km ENE of Yaiza, 320 m, 13 Apr. 1975, *Krog and Østhagen 1055* (O, UPS, isotypes).

Notes: The presence of fertile apothecia (*i.e.*, with mature asci and ascospores) in *R. lacera* is evidently very rare (Krog and James 1977; Krog and Østhagen 1980). In specimens from Canary Islands, Krog and Østhagen (1980) found apothecia, but without mature ascospores; whereas Kashiwadani and Nash (2004) did not find specimens with apothecia in the Greater Sonoran Desert Region. Krog and James (1977) mentioned the presence of mature ascospores in European material, giving the dimensions as 10–15 × 3–5 µm. This size range matches the dimensions of the ascospores found in Brazilian specimens.

According to the literature and our analyses, *Ramalina mollis* is very similar to *R. lacera* in their chemistry, ecological features and overall morphology. Krog and Østhagen (1980) distinguished *R. lacera* from *R. mollis* by the presence of soralia and rare presence of apothecia in the former, and by the absence of soralia and to usual presence of apothecia in the latter species. Both are identical in anatomical features too, however, molecular studies are needed to clarify the relationships between these two species (*i.e.*, whether they represent a monophyletic group) and whether they represent a pair of monophyletic clades that correspond to the presence and absence of soralia. While *R. lacera* has been reported from various localities around the world, *R. mollis* is known only from the Canary Islands and parts of Spain (Krog and Østhagen 1980; Stolley and Kappen 2002).

According to Kashiwadani and Nash (2004), *Ramalina lacera* might also be confused with *R. canariensis*. However, *R. lacera* has monophyllous main laciniae with marginal secondary branches, no chondroid tissue, a single-layered cortex and produces bourgeanic acid in the medulla. Whereas *R. canariensis* has palmately or irregularly branched laciniae, chondroid tissue present, a two-layered cortex and produces divaricatic acid in the medulla.

As conclusion, considering the previous studies (*e.g.*, Nylander 1870; Vainio 1890; Zahlbruckner 1902; Fleig 1988; Kashiwadani & Kalb 1993; Kashiwadani *et al.* 2007), the number of species of *Ramalina* known from Brazil is raised to 25.

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